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SHEEP
SCAB



SHEEP SCAB is a highly contagious skin disease caused by minute insectlike parasites known as mites. Four different varieties of scab mites affect sheep, causing four different kinds of scab known as psoroptic, sarcoptic, chorioptic, and demodectic scab or mange.

Psoroptic or common scab and chorioptic or foot scab can be eradicated by dipping infected sheep twice in warm lime-sulphur or nicotine dip with an interval of from 10 to 14 days between dippings. Sarcoptic scab, also known as head scab or black muzzle, can be cured by repeated dippings in the above-named dips every five or six days for a month or six weeks. No known method is satisfactory for eradicating demodectic scab, which infects the hair follicles of sheep and goats.

Directions for detecting scab, selecting or making dip, dipping sheep, and building dipping vats are given in this bulletin.

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SHEEP SCAB

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VARIETIES AND GENERAL CHARACTERISTICS

SCABIES IN SHEEP, commonly known as scab or mange, is a term applied to a group of contagious skin diseases caused by insectlike parasites known as mites, which live on or in the skin. The four species of these parasites which affect sheep are classified in four different genera, as follows: (1), *Psoroptes*; (2), *Sarcoptes*; (3), *Chorioptes*; and (4), *Demodex*.

The mites cause wounds or lesions in the skin of the host animal, and as each kind of mite possesses distinctive habits, the nature and especially the location of the lesions are more or less characteristic. The psoroptic mites, which cause common scab, live in groups or colonies on the surface of the skin and the lesions usually appear on the body. The sarcoptic mites burrow into the skin, making galleries in which they live and reproduce. The lesions appear on the head and face, and occasionally on other parts where there is little or no wool. The chorioptic mites live in groups on the surface of the skin, but usually remain localized on the legs. The demodectic mites are truly microscopic in size, smaller than those mentioned, and in appearance are more like worms than true mites. They live in the hair follicles and glands of the skin and cause hard pimples or nodules.

PSOROPTIC OR COMMON SCAB

Psoroptic or common scab is the most important form of sheep scabies with which the industry in the United States has had to contend. It is a highly contagious skin disease, easily transmitted from one sheep to another by contact, and spreads very rapidly after being introduced into a flock. The disease is not hereditary, but a newborn lamb may become infected from a diseased mother. When allowed to spread, sheep scab causes great financial loss. These losses are caused by (1) a decrease in the quantity of wool produced, (2) loss in weight and general condition from irritation and other effects of the disease which render the animals unthrifty, and (3) the death

of large numbers of infected sheep. Although the disease is highly contagious, insidious in its nature, and severe in its effects, it yields readily to proper treatment and is easily cured. A sheep owner should never allow scab to remain in his flock, as it can be easily eradicated by proper dipping.

THE PARASITE WHICH CAUSES COMMON SCAB

The mites which cause common scab are small white or yellowish parasites known technically as *Psoroptes communis ovis* or *P. ovis*, the mature female measuring about one-fortieth and the male about one-fiftieth of an inch in length. They are visible to the naked eye,

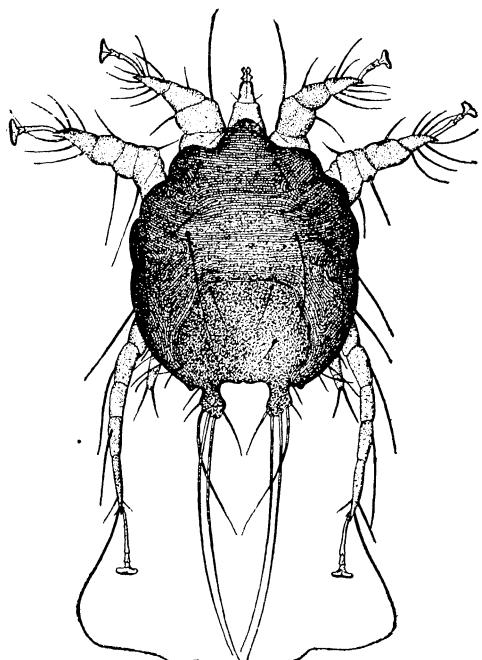
especially when they are placed on a dark background. The general form of the body is oval or egg shaped, and the tapering head is longer than broad. These mites when mature have four pairs of legs, all of which extend beyond the margin of the body (figs. 1 and 2).

The entire life cycle is passed on the body of the host animal. Each female may deposit from 15 to 24 eggs, which usually hatch after four to seven days' incubation. The young mites reach maturity, mate, and the females deposit eggs in from 10 to 12 days. These stages in the life history have an important bearing on the interval which should elapse between treatments.

Dipping, if properly done, kills all the mites, but can not be depended on to destroy all the eggs. Some of the eggs will survive dipping and they may hatch after the first dipping, forming a new generation of mites. To complete the treatment this new generation should be destroyed by a second dipping before they have had time to develop and deposit eggs. As the period of incubation on the host is from 4 to 7 days, and probably never exceeds 10 days, and as the young mites do not begin depositing eggs until they are 10 or 12 days old, it is evident that the interval between the first and second dippings should be from 10 to 12 days. Practical experience has shown that the interval between dippings may be extended safely to a maximum of 14 days; however, the 10 to 12 days' rule should be followed whenever possible.

FIG. 1.—Sheep-scab mite (*Psoroptes ovis*). Male. Dorsal view, greatly enlarged. (After Salmon and Stiles, 1898.)

destroy all the eggs. Some of the eggs will survive dipping and they may hatch after the first dipping, forming a new generation of mites. To complete the treatment this new generation should be destroyed by a second dipping before they have had time to develop and deposit eggs. As the period of incubation on the host is from 4 to 7 days, and probably never exceeds 10 days, and as the young mites do not begin depositing eggs until they are 10 or 12 days old, it is evident that the interval between the first and second dippings should be from 10 to 12 days. Practical experience has shown that the interval between dippings may be extended safely to a maximum of 14 days; however, the 10 to 12 days' rule should be followed whenever possible.



SYMPTOMS OF COMMON SCAB

When the scab mite finds lodgment on a sheep it pricks the tender skin to obtain food, and in so doing probably introduces a poisonous saliva into the wound. A slight inflammation is caused, made manifest by a reddening of the skin. This stage of the disease is rarely if ever detected by casual observation (fig. 3). As the mites multiply large numbers of small wounds are made in the skin and are followed by intense itching, with formation of papules, inflammation, and exudation of serum. The serum, which oozes to the surface, becomes mixed with the natural excretions and particles of dirt, and more or less infested with microorganisms. This mass soon hardens into crust or scabs in the wool; these in the early stages are of a yellowish color, but as the disease advances and the scabs thicken they become dark from bloodstains, dirt, and other causes. When the disease begins only a small pimple can be seen, but as the mites multiply they seek the healthier parts around the edges of the diseased area, and thus the lesion or scab is continuously enlarged. The areas of the skin affected become hardened and thickened. This is readily detected by pinching up a portion and comparing it with the surrounding healthy skin. Other conditions resembling scab rarely if ever cause this characteristic, uniform thickening of the skin. When the affected skin is pinched or handled, the sheep as a rule turns its head toward the lesion, thrusts out the tongue, licks the lips, and champs the jaws.

The intense itching causes the sheep to become restless. This irritation is particularly noticeable after the animals have been driven, as itching is more intense when they are heated. They bite and scratch themselves and rub against any available object, including other members of the flock. The natural position of the wool is disturbed by these efforts to obtain relief, and as more or less wool

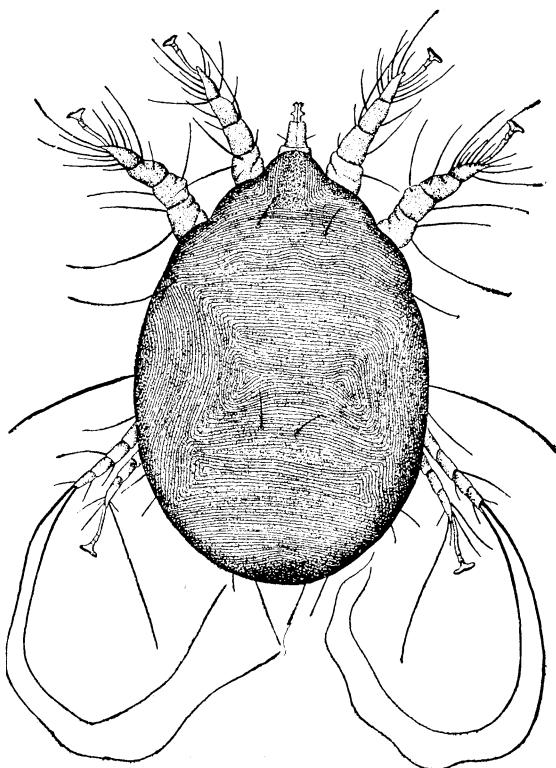


FIG. 2.—Sheep-scab mite (*Psoroptes ovis*). Female. Dorsal view, greatly enlarged. (After Salmon and Stiles, 1898)

is pulled out, the fleece assumes the condition known as "broken" (fig. 4). At first the wool on the affected parts, if within reach of the mouth, is seen to have been chewed and some of it pulled out. The wool on affected parts not within reach of the mouth has a discolored, worn, or ragged appearance, caused by scratching with the hind feet or rubbing against other objects. At this stage the marks of the mouth or feet on the fleece or the disturbed position of the wool may be the only visible symptoms, unless close examination is made of each individual sheep (fig. 5). As the disease advances increasingly large areas become entirely denuded of wool. Scabs fall and are replaced by thicker and more adherent crusts. The skin

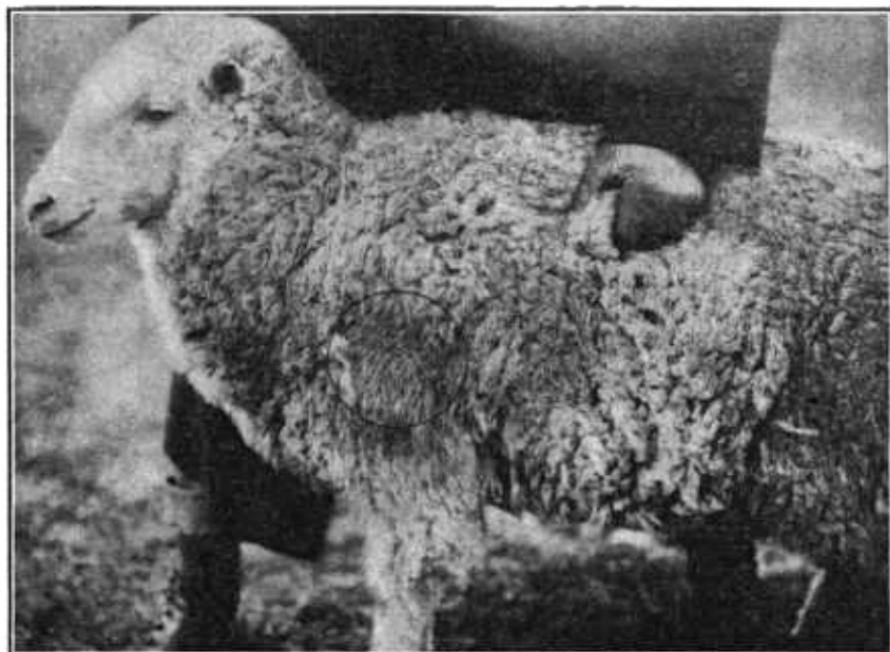


FIG. 3.—First stage of scab on shoulder, showing natural position of wool disturbed by biting and scratching

finally becomes more or less bare, tumefied, is greatly thickened, and may crack and bleed. Unless properly treated many of the animals will die.

DETECTING SCAB IN THE EARLY STAGES

The most certain diagnosis consists in demonstrating the presence of the parasite (*Psoroptes communis ovis*), which alone causes the disease. To obtain specimens of live mites one of two methods is usually employed: (1) Lifting the mite from the surface of the skin with the point of a knife blade, and (2) taking scrapings of wool and epidermis containing the mites and isolating the parasites from the scrapings. To obtain mites with a knife blade good light is necessary. The wool around the affected area is suddenly parted with the forefinger and thumb, and by the aid of a magnifying glass or even with the naked eye the mites can often be seen moving

rapidly away from the light. When they are thus found they can often be picked up on the end of a knife blade.

When scrapings are taken the outer edges of the infected areas should be scraped with a blunt-edged knife. The mass of scrapings is transferred to a smooth, black surface, such as the brim of a black hat or a piece of black paper. To make the mites active the temperature should be approximately the temperature of the body. Spreading the scrapings in the bright, warm sun or near artificial heat will usually cause the mites to become active, and they can be seen as minute, gray, moving bodies against the dark background. They are plainly visible under a low-power hand lens.

When the mites are producing active irritation the surface of the skin in the immediate vicinity of the lesion is greasy and appears

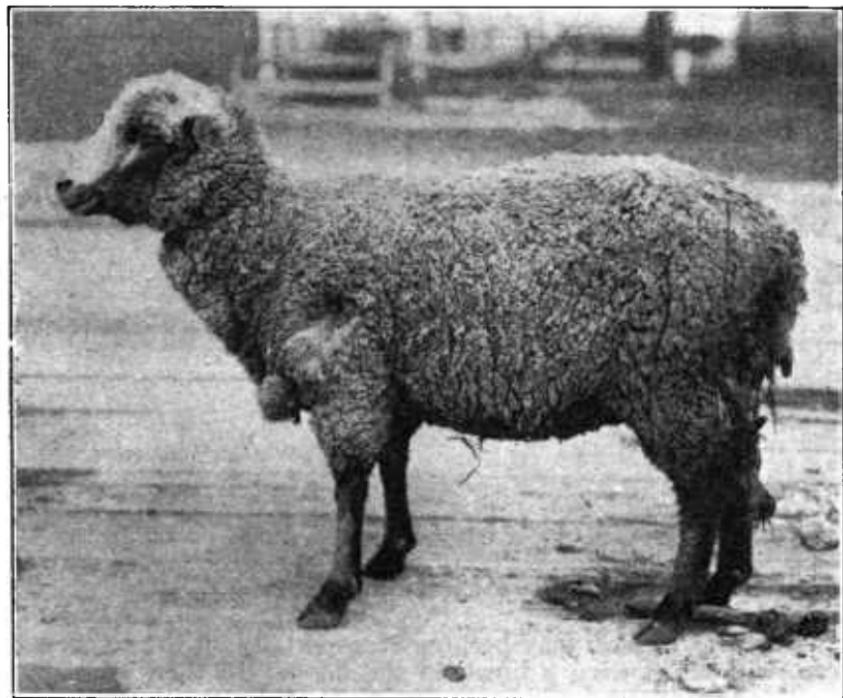


FIG. 4.—First break in fleece, early stages of scab; lesions on shoulder

bright and glistening or white and glossy. Under such conditions the mites are usually present in large numbers and are easily found. On the other hand, if the lesion is dull and dry in appearance it indicates that the mites are inactive at that point and that they will be difficult to find. Usually the latter condition is found in the center of a patch of scab of comparatively long standing or where the mites have been destroyed or rendered dormant. The white, glossy appearance is seen in cases of recent infestation or on the outer edges of old lesions. It is often difficult to find mites during the cold, stormy weather, as they apparently leave the infested area, where the wool is light, and seek shelter where it is heavier.

Any condition which causes the sheep to bite and scratch should be investigated at once and the cause definitely learned. Scab on certain parts of the sheep's body may be overlooked. It is usually found on the back or sides, but may start on any part of the body. Lambs are sometimes infected around the head between the horns and ears, and as these parts are frequently covered with dirt the lesions may not be noticed unless close examination is made. Scab mites are sometimes found in the ear and in the groove beneath the eye, which may explain some cases of fresh outbreaks after treatment, the mites in these places surviving imperfect dipping. On wrinkled breeds, and especially on the bucks of these breeds, scab may be so well concealed in the wrinkles as to render its detection difficult. The breasts and bellies of suspected bucks of all breeds should be closely examined, as these parts are frequently affected. In some cases a con-



FIG. 5.—Characteristic scab lesion in early stages of the disease

siderable area of scab may be present, especially on the back of the sheep, without causing a break in the fleece. In these cases, most often found in tight-wool sheep, the wool will be "raised" from the skin but is held so firmly by the surrounding wool that it may escape detection. Bucks are not so sensitive to the effects of scab as other sheep; consequently they may have scab a long time without showing any breaks in the fleece. In some cases they do not bite or rub the affected parts enough to cause dislodgment of the wool.

Well-advanced cases of hard scab are usually easy to diagnose, but the disease should never be allowed to reach this stage, as it entails heavy loss to the owner and the entire premises may become infectious. The experienced sheep grower realizes that a case of common scab, if neglected and allowed to spread, will materially reduce the profits and often place the balance on the wrong side of the ledger.

CONTAGIOUSNESS OF COMMON SCAB

Each species of domesticated animal has its own peculiar species or variety of psoroptic scab, and common sheep scab is not transmissible to other animals, except goats. It is, however, highly contagious to all classes of sheep, and is transmitted by direct contact with animals or objects that are carriers of the mites. Although it has been accepted as a fact that the mites are unable to propagate except on sheep, it is well known that they may live on goats for a long period and cause characteristic lesions of scab; consequently, goats

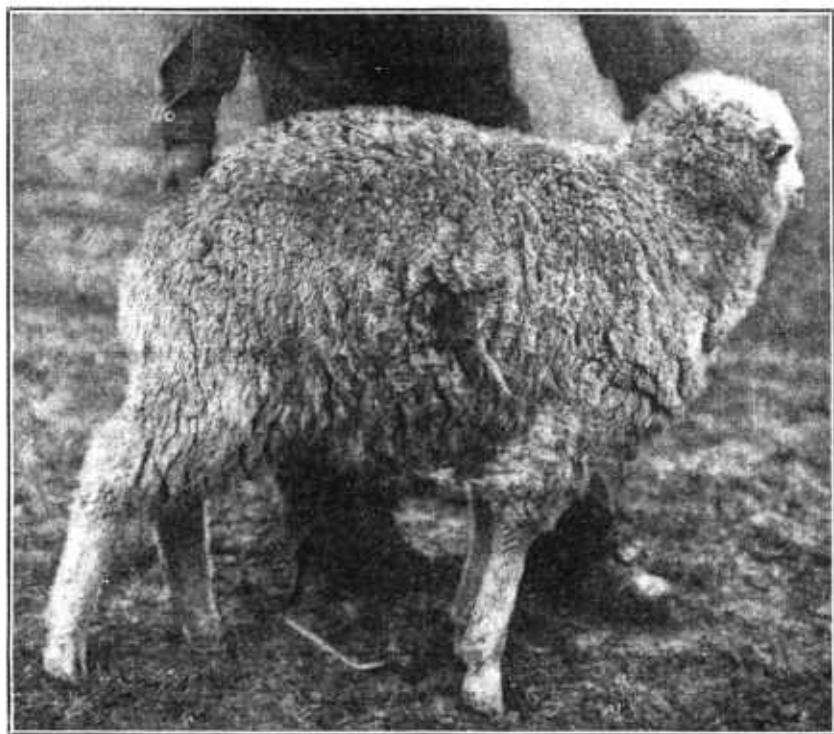


FIG. 6.—A case of scab more advanced than that in Figure 5, showing area denuded of wool

and other animals herded with sheep should be dipped or treated in the same way as the latter.

The most important factor in spreading scab mites is the infected animal, and practically all cases of sheep scab are contracted by contact with infected sheep. In many cases it is difficult to ascertain the source of infection, especially in range flocks, but the two known factors of great importance are "public buck herds" and "strays." The public buck herd should always be closely inspected or dipped just prior to the time the animals are to be distributed to the various owners. Stray sheep which may be infected often find their way into clean flocks, and the herders may not know when or where the "strays" joined the flock.

The possibility of sheep becoming infected from infectious premises should not be overlooked. Various data which have been collected relative to the vitality of the common sheep-scab mite show that when removed from the host the mites commonly live from two to three weeks, and cases of their survival for as long as two months have been recorded. Other things being equal, scab mites will live longer off the host in a cool, moist atmosphere than in a warm, dry one.

The results of a large number of experiments show that usually clean sheep do not contract scab from so-called infectious premises. Occasionally, however, they may become infected from premises or old bed grounds, if such places are used by clean sheep within 30 days of the time they were occupied by scabby sheep. It seems very probable that infected premises which have been vacant for about a month are safe after that time for use by clean sheep. Freshly dipped sheep do not become infected from infectious premises, and

flocks may safely be held on such premises between the first and second dippings. It is good sanitary practice to avoid old bed grounds and uncleansed corrals and premises, but there is practically no danger of scabies infection from such places after 30 days.

Small inclosures used for sheep should be kept clean, and if they have been occupied by scabby sheep the premises should be cleaned and disinfected. Remove all litter and manure, cleaning down to a smooth surface, and spray all exposed surfaces with coal-tar-creosote dip.

The transmissibility of the disease to a flock is not limited to any one season of the year, although during the summer months cases of recent infestation are rarely seen. Scab often remains dormant during hot, dry weather and assumes the appearance of having

been cured, but usually becomes evident again with the advent of cold, rainy weather.

The susceptibility of the various breeds to common scab varies somewhat in different sections, but as a rule the disease develops more rapidly in fine-wool sheep than in the loose-wool breeds. Fine-wool sheep succumb rapidly to an attack, and treatment to be successful must be carefully applied, because the grease or yolk in the fleece retards the penetration of the dip.

Previous attacks of the disease do not confer immunity, and a flock may become infected any number of times if exposed to the infection. As a rule the visible symptoms of reinfection do not appear until after 30 days or more after the last dipping. The dip that remains in the wool after dipping often serves for a limited time as a preventive against reinfection. A dip containing sulphur may usually be depended on for 60 or more days to afford protection against reinfection if the dip is not washed out of the fleece by rain or otherwise.

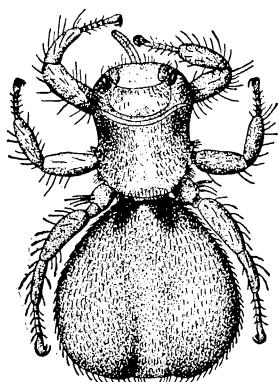


FIG. 7.—Sheep tick (*Ixodes ovinus*). Male. Dorsal view, enlarged. (From Curtice, 1890.)

CONDITIONS WHICH MAY BE MISTAKEN FOR COMMON SCAB

Any parasite or condition which causes itching and thus leads the sheep to scratch themselves may temporarily be mistaken for scab, but if it is remembered that scab is caused only by scab mites, and that unless they are present there can be no scab, the diagnosis is rendered more simple.

Common sheep scab may be differentiated from conditions caused by other parasites, such as sheep ticks, common ticks, and lice, by finding the parasite and by the nature of the lesion. If the itching is caused by ticks, an examination will reveal the ticks (fig. 7). They are much larger than the scab mites and are of a dark-brown color. If lice (figs. 8 and 9) cause the sheep to scratch, they can be found on examination, and as they are much larger than a scab mite, they are easily identified. Ticks and lice do not, as a rule, produce pronounced local lesions. They move more or less from place to place on the skin, so that scratching and biting are not repeated persistently in one place, as in the case of scab. It should be remembered, however, that ticks or lice may be present on scabby sheep and that their presence in itself is not enough to warrant the exclusion of scab as a possibility in the diagnosis.

Bearded seeds of grass and weeds, thorns and spines from cacti and various other plants often become lodged in the fleece and prick the skin, setting up an irritation which causes the animal to bite and scratch. In this way wool is pulled out in small tags and the fleece often presents a ragged or broken appearance. The bearded seeds or thorns sometimes penetrate the skin, causing an abscess. On close examination the causative agent can usually be found and removed.

Eczema, wildfire, summer sores, inflammation of the sebaceous glands, rain rot, shear cuts, sunburn, and the effects of alkali dust on areas denuded of wool may be mistaken for scab by those who are inexperienced.

Eczema is an inflammatory condition of the skin and is usually accompanied with itching and the formation of crusts, and in some cases scabs. It is differentiated from scab by the fact that it does not cause the characteristic thickening of the skin found in common scab, and the mite is not present.

Wildfire, so called, affects sheep mainly in the Northwestern States. It causes the sheep to bite and scratch and the pulling of the wool causes breaks in the fleece. On examination of the infected sheep the skin is found to be red and inflamed, but is soft to the touch. It is not hardened and thickened, as in scab.

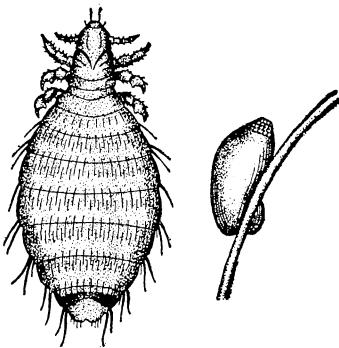


FIG. 8.—Sheep foot louse (*Hamato-pinus pedalis*). Adult female and egg, enlarged. (From Osborn, 1896)

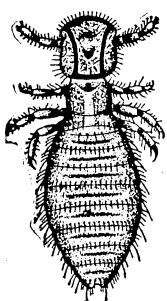


FIG. 9.—Sheep louse (*Trichodectes sphaeroccephalus*). Adult female, enlarged. (After G. Neumann, 1892)

A condition commonly known as summer sores exists among sheep in some localities. It appears as an irritating sore on the skin. The sheep bite and scratch the affected parts until the wool is pulled out and the skin becomes raw and bleeding. It is differentiated from scab by the absence of the scab mite, the character of the lesion, and the fact that the skin is not thickened in the characteristic manner.

Inflammation of the sebaceous glands may be mistaken for scab. There is severe itching, the skin is red and sensitive, and there is an excretion of a strong-smelling, yellowish, viscid yolk. The skin does not have the characteristic appearance of scab and the mite is not present.

In rain rot, a condition occurring in rainy weather, an eruption may appear on the skin which may be mistaken for scab. There is, however, no parasite present, itching is absent, and the trouble disappears when dry weather comes.

Shear cuts, sunburn, and the effects of alkali on the skin are conditions found in sheep after shearing. They are easily differentiated from common scab by the character of the lesions and the absence of the scab mites.

TREATMENT FOR COMMON SCAB

The only rational treatment for common scab consists in using some external applications which will kill the parasites. Feeding sulphur and salt and various other preparations to sheep will not destroy the mites, and consequently will not effect a cure. Hand dressing, commonly called "spot doctoring," consists in soaking the affected parts with warm dip. This tends temporarily to check the disease, but will not effect a cure. When dipping can not be done because of cold weather or other reasons, isolation of the visibly affected animals and hand dressing is advisable. All sheep having hard scabs should be separated from the flock just prior to dipping, and the scabs soaked well with warm dip and the crusts or scabs broken up by rubbing with a cob or stick.

Two dippings from 10 to 14 days apart are necessary to cure common scab. The first dipping kills the mites but does not destroy the eggs. The eggs hatch and form a new generation of mites, which must be destroyed by a second dipping before they have had time to lay eggs. The proper interval between the first and second dippings is from 10 to 12 days, but it may be extended to a maximum of 14 days.

The dips commonly used and permitted by the Bureau of Animal Industry for use in official dippings of sheep for scabies are lime-and-sulphur and nicotine solutions. Two dippings 10 to 12 days apart in either one of these dips can usually be depended on to cure cases of common scab if the dips are properly used.

SARCOPTIC OR HEAD SCAB

Sarcoptic scab, commonly known as "head scab" or "black muzzle," is found on sheep in Europe but is not common in the United States. The mite (*Sarcoptes ovis*) which causes the disease burrows into the skin of the head and face where there is little or no wool. The irritation and itching cause the animal to rub and scratch the affected parts, and the hard scabs which are formed are firmly

attached to the underlying skin. This disease may be distinguished from common scab by the nature and location of the lesions and its tendency to remain localized on those parts of the skin which are not covered with wool.

Sarcoptic scab is difficult to eradicate, but the disease can be cured by careful, persistent, and repeated treatments. Thorough soaking of the affected parts with warm lime-and-sulphur dip every five or six days for a month or six weeks will usually be effective.

CHORIOPTIC OR FOOT SCAB

Chorioptic or symbiotic scab, commonly known as "foot scab," is caused by a mite (*Chorioptes ovis*) which closely resembles the common scab mite. The parasites live in groups or colonies on the surface of the skin, usually on the lower parts of the legs and around the feet, but in severe cases they may spread to the inner surface of the thighs and to the udder. The visible lesions usually occur first around the feet and are most pronounced during cold weather, when the flock is housed. The disease is distinguished from common scab by the location of the lesions around the feet and on the limbs, and the failure to spread over the body.

The disease is easily cured, and the treatment recommended for common scab is effective against foot scab. Wading tanks filled with dip may be used during cold weather instead of dipping vats.

DEMODECTIC OR FOLLICULAR SCAB

Demodectic scab, also known as follicular mange, is not common in sheep in the United States, but cases have been reported in milk goats. Since milk goats are becoming widely distributed in this country, veterinarians and breeders should be on the lookout for symptoms of the disease.

The mite (*Demodex folliculorum*) which causes demodectic mange is not visible to the naked eye. They are small, wormlike mites which infest the hair follicles and sebaceous glands, and when present in large numbers they cause swellings or nodules which extend deeply into the skin. The nodules may vary in size from that of a grain of wheat to the size of a walnut. The favorite location in sheep is around the eyelids and in goats around the neck and sides. As the hair over the lesion does not usually fall out the nodules are not readily visible, but they can be detected by passing the hand lightly over the affected area.

The content of the nodules usually is a thick, cheesy mass, which sometimes may be pressed out without lancing the nodule. When the nodules are pressed the discharge may mold or have the appearance of a worm or grub, but on close examination the mass is found to be made up of mites, eggs, and excretions of the skin.

Mature goats appear to be more susceptible than young ones, and the disease spreads slowly by direct contact with infected animals. No reliable method is known for the successful treatment of flocks infected with demodectic mange. Infected animals may be treated by opening all the nodules, removing the contents, and syringing the pockets out with a 2 per cent solution of coal-tar-creosote dip. Some investigators report good results from the use of a few drops

of a saturated solution of carbolic acid in each pocket. After the undissolved acid has settled to the bottom of the container the upper part of the solution may be poured off and used as directed above.

Infected animals should be removed from the flock and treated or destroyed, and as a precautionary measure the flock should be dipped several times in coal-tar-creosote dip.

DIPPING SHEEP

Dipping consists in immersing the sheep in a medicated solution that will kill the parasites, and is the only practical method known for eradicating scabies from the flock. The usual method is for the sheep to enter one end of a vat filled with dip, through which they swim, and leave the vat at the opposite end. The dip or solution should be used warm, in order that it may penetrate the fleece and hard scabs or crusts.



FIG. 10.—Dipping sheep in concrete vat, showing entrance

Two or more dippings are necessary to effect a cure. As a basis of practice it may be stated that one dipping will not cure scab. Sheep in full fleece will retain more of the dip in the wool than freshly shorn sheep or lambs with short wool. Occasionally one dipping will cure cases of common scab and also of foot scab in sheep having heavy fleeces. The reason is that sufficient dip remains in the wool to kill the new crop of mites which hatch after the first dipping. One dipping, however, can not be depended on to cure scab, and it will fail to do so in the large majority of cases. The entire flock should be dipped, regardless of the number showing infection. To pick out the ones showing scab and dip no others will result in failure, as the disease will continue to develop in the undipped portion of the flock.

If the dipping is to be successful it is necessary to give close attention to the details and to see that the work is carefully and thoroughly performed. Sheep should not be dipped immediately

after shearing; a period of at least 10 days should elapse between shearing and dipping, in order that the shear cuts may heal. It is dangerous to dip sheep in some of the dipping preparations, especially lime-and-sulphur, if there are any fresh wounds on the animals; consequently dogs that bite the sheep should not be allowed in the dipping corrals. The chutes, pens, and dipping vat should be closely examined for nails, broken boards, or any object that may puncture or wound the skin of the sheep. Animals having fresh wounds when dipped in lime-and-sulphur usually develop a condition commonly known as "blood poisoning," and the mortality from this cause is high. It does not occur unless there are fresh wounds on the skin. After the wounds have granulated or healing is well started there is little or no danger from this cause. Rough handling of the sheep at the time of dipping results in more harm and damage to the flock than is caused by the dip. When sheep are placed in the



FIG. 11.—Dipping sheep in wooden vat, showing exit

dipping vat by hand the men handling them should be instructed to do so carefully. They should not be allowed to catch the sheep by the ears; this is sometimes done and has resulted in breaking or bruising the skin, causing the heads to swell after dipping and resulting in considerable death loss.

Ewes and lambs should not be dipped together. The lambs should be "cut out" and dipped separately, and they need not be held in the swim so long as the older sheep. If the ewes and lambs are put into the vat at the same time the danger of drowning some of the latter is much greater than when they are dipped separately. It has been stated that the ewe recognizes her lamb more readily when they are dipped together; this however, is probably not correct. A ewe recognizes her lamb by smell and not by sight; consequently after the flock has been dipped and the ewes and lambs have been turned in together there is considerable commotion for a time, as the ewes fail temporarily to recognize their offspring. However,

the members of the flock will adjust matters for themselves, and as a rule practically every lamb will be recognized by its mother. It often happens that an undipped sheep will jump out of the pens and get in with those that have been dipped. This should be carefully guarded against and all such sheep dipped before the flock leaves the vat. By looking the dipped sheep over it is easy to detect any undipped sheep that may have become mixed with the dipped ones.

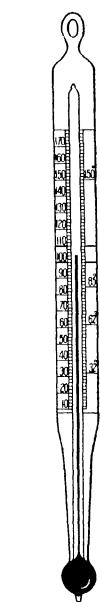
Prior to bringing the sheep to the vat for dipping they should be watered and fed, so as not to be thirsty or hungry at the time of dipping, although they will probably stand the effects of dipping better if not too full of feed and water when dipped. If they are watered and fed from three to six hours before dipping they will

probably be in the best condition for the operation.

When the weather is cold or stormy dipping operations should be commenced early in the morning and finished for the day in time to give the last sheep dipped opportunity to dry off before night. During winter weather dipping for the day should be finished by noon, so that the flock may have time to dry off and fill up with feed before night, as a sheep with a full stomach will withstand much cold and hardship. By observing these precautions sheep may be dipped with reasonable safety during cold weather.

Bucks should be dipped separately from ewes and lambs. They should not be driven fast and then put into the vat before resting and cooling off. As they succumb very easily in the vat, it is necessary to give them careful attention. Hard scab on rams is difficult to cure, and they should be held in the swim from three to five minutes. The hard scabs should be broken up by manipulation, so that the dip may penetrate to every part. At the large vats the buck herds are usually dipped first, while the vat is full, so as to afford them more swimming room.

FIG. 12.—*Float-ing dairy ther-mometer*



For dipping purposes soft water is better than hard; apparently some of the ready-prepared dips do not mix properly and are not effective with hard water. If hard or "alkali" water must be used it is improved and its effects on scab increased if it is softened or "cut" by adding lye or sal soda, but no more should be added than is required to cut the water. An excess of potash tends to injure the wool and cause an irritation of the eyes.

DIRECTIONS FOR DIPPING

The quantity of dip in the bath should be sufficient to submerge the sheep completely. The depth of the dipping fluid in the vat should be from 40 to 48 inches, depending on the size of the sheep. The quantity of fluid necessary to fill the vat to the required depth should be ascertained before it is prepared. Freshly shorn sheep and short-wooled lambs will carry out on an average from 1 to 2 quarts of dip, depending on the size of the sheep and the length and grade of wool, while a full-fleeced, fine-wool sheep will carry out and retain in the fleece as much as two gallons. At late fall dipping the

average medium-wool sheep will retain in the fleece about 1 gallon of dip. In estimating the quantity of dip required these facts should be taken into consideration. After computing the dip required to charge the vat, the average quantity of dip which each sheep will carry out should be estimated; this should be multiplied by the number of sheep to be dipped and the product so obtained added to that required to fill the vat. If the vat and draining pens are watertight, so that no dip is lost through these sources, the total as given above should show the approximate number of gallons of dip required to complete the work.

The temperature of the dip should not be a matter of guesswork, but should be ascertained accurately by using a thermometer. If it is too high the sheep may be injured, and if too low failure to cure will probably result. In field operations, when the dipping is supervised by inspectors, the temperature of the dip is maintained at 100° to 105° F. Practice has demonstrated that the lime-and-sulphur and nicotine dips should be used at these temperatures. The coal-tar-creosote and cresylic-acid dips should be used at slightly lower temperatures, the maximum being 95° F. For use in dipping small lots of farm sheep an ordinary dairy thermometer will answer the purpose. At the large vats, where a great many sheep are to be dipped, at least two thermometers should be provided as a precaution against breakage and delay. The thermometers used at dipping vats should be tested occasionally by comparison with another thermometer, so as to be sure that they are registering properly (figs. 12 and 13).

After the vat is filled to the required capacity the contents should be well mixed by stirring, in order that the temperature may be uniform throughout. A good method of stirring the dip in large vats is to take a 5-gallon pail or dip container, punch holes near the top, insert a wire for a bail, allow the can to fill and partially sink, then drag it rapidly from one end of the vat to the other, and repeat the process until the temperature is uniform, as shown by temperatures taken at several points in the vat. Stirring plungers are useful implements, and, as they are easily made, one or more should be provided at every vat. They are used in a manner similar to the movement of the dasher of an old-fashioned hand churn. The plunger is pushed to the bottom of the vat and raised rapidly, the process being repeated as the operator moves slowly along the vat. The style shown in Figure 14 is the one most commonly used. The dip should be changed as soon as it becomes filthy, regardless of the number of sheep that may have been dipped in it. In emptying the vat the entire contents should be removed, including all sediment and foreign matter. After the liquid portion has been dipped out or drained off all the sediment and dirt at the bottom should be removed and the bottom cleaned by sweeping or scraping with a hoe or spade. After the lime-and-

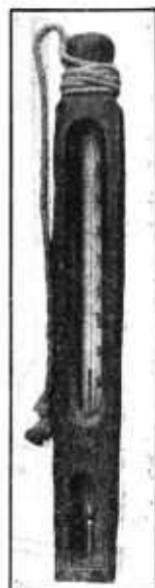


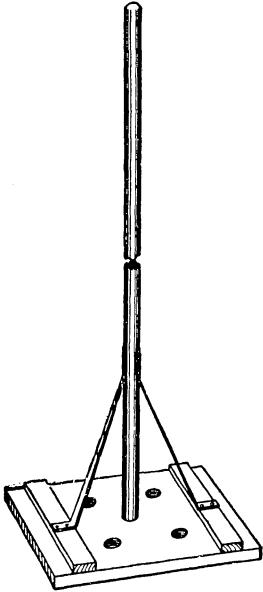
FIG. 13.—Thermometer used by Bureau of Animal Industry inspectors, in holder whittled from a block of wood

sulphur dip has been mixed to the proper strength for dipping and used in the vat, it should not be used again after it is 10 days old. This is a safe rule to follow with any of the sheep dips, as losses often occur from dipping in old or stale dips.

The time that infected sheep are held in the dip should in no case be less than two minutes. If the scab is not advanced, from two to three minutes in the vat is sufficient; but in well-advanced cases of hard scab on fine-wool sheep, especially bucks, better results are obtained if they are held in the vat from three to five minutes during the first dipping. If the hard scabs and crusts are broken up and soaked with dip before the sheep are dipped, it is not necessary to

hold them in the vat longer than two minutes. In all cases in which the scab is advanced it is recommended that the hard scabs be broken and hand dressed with a solution of the dipping fluid, so as to soak the affected parts well. In hand dressing such spots care should be taken not to cause the wound to bleed, as the blood will tend to protect the mites from the effect of the dip. After hand dressing such sheep allow at least one hour for the scabs to become soaked before placing the sheep in the vat. The time the sheep are in the vat should not be a matter of guesswork. A watch or a two-minute sand glass should be used to make certain that the animals remain in the dip for a sufficient length of time. Where a large vat is used and the sheep are running fairly well it is possible, after a little practice, to arrive at an average working rule as to how many sheep are to pass through the holding gate each time it is raised.

Drowning sheep in the vat can be avoided by proper care. Men with dipping forks should be stationed along the vat on both sides to attend to the sheep and prevent accidents.



When the vat becomes filled with sheep their progress is retarded, and the tendency is for each sheep to place its front feet on the back of the sheep in front and thus raise its fore quarters out of the dip. The men along the vat should prevent this by keeping the sheep properly arranged in the vat. The dipping forks should be used to keep all of the sheep's body submerged but its head while it is passing through the vat. This can be done by placing the dipping fork over the shoulders of the sheep and gently but firmly pushing it under the dip. The animal will raise its nose so that the neck and part of the head can be submerged without danger of strangling. Old ewes that have been dipped a number of times are sometimes difficult to handle, both in the chutes and in the dip. They will often lie on their sides in the vat, bracing themselves with their feet against one side and their backs against the other. When pushed under they will make efforts to regain this position and may

strangle. Sheep that are affected by eating loco weed often drown in the vat unless they are piloted through. When strangling occurs the sheep should be taken from the vat. If it does not get upon its feet, pull the tongue forward, dash cold water over the head and body, and, if necessary, induce artificial respiration. When it has acquired sufficient strength, and if it has not been in the dip long enough, the animal should be returned to the pens and piloted through the vat again.

DIPPING FORKS

In using large vats dipping forks are necessary for the efficient handling of the sheep and should be provided as part of the equipment at every plant. A number of different styles are made, but the two shown in the illustration are the ones commonly used. The one with both hooks turned upward seems to have the preference, for the reason that when it is in use either side may be hooked under the neck of the sheep for raising the head in case of strangling (fig. 15). The handles should be strong and from 5 to 6 feet long. The hooks should be made of half-inch round iron and firmly held in the handle by an iron ferrule. These forks can be bought ready made or may be made by any blacksmith.

CHOOSING A DIP

There are many dipping preparations on the market. The farmer or sheepman should not be deceived by exaggerated statements made by manufacturers. He should know the nature of the dip he is using and its effects on the sheep when used in the kind of water which he has available. If a ready-made dip is to be used, one should be selected that will kill the parasites and not cause undue injury to the sheep. Almost any of the better-known, ready-prepared dips will be satisfactory if used according to directions and with pure water. If the dipping plant is not supplied with pure, soft water, a dip should be selected that will work well in the kind of water available. Lime-and-sulphur dip mixes properly and is effective with almost any kind of water. The coal-tar-creosote and cresylic-acid dips apparently do not mix uniformly with some of the hard waters, and they should not be used with such waters.

The dips on the market to-day can be divided into five general groups—those containing arsenic, the cresylic-acid group, coal-tar-creosote dips, nicotine, and lime-and-sulphur. Of these the Bureau of Animal Industry recognizes only two groups for the official dipping of sheep for scabies, namely, lime-and-sulphur and nicotine.

It has been determined from actual experience over a large field that dips deteriorate by use; that is, after a number of sheep have passed through the vat the active principle of the dip falls below the standard required for effective work. In order to overcome this

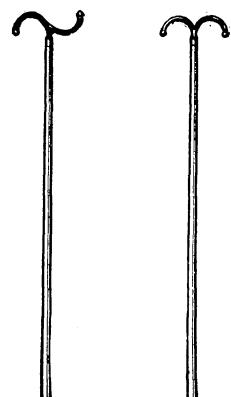


FIG. 15.—Two styles of dipping forks

difficulty and keep the dip up to standard while being used, chemical testing outfits have been designed that can be used at the vat to determine the percentage of the active principle in the dip at any time.¹ In this way the strength can be kept up to the required standard. Before approving a dip for use in the official dipping of sheep, one of the requirements of the Bureau of Animal Industry is that there shall be a practical field test for such dip. Of the five general classes of sheep dips named above, excluding arsenical dips for other reasons, the lime-and-sulphur and nicotine are the only ones for which at present there is a practical field test.

Whatever dip is selected, the sheep grower should not forget the fact that there are two ways of using it. One way is to use it according to directions given; the other way is to attempt to economize time, labor, or money by using it in weaker proportions than advised and by hurrying the sheep through the swim or failing to dip all the sheep in the flock. If the former method is adopted with any of the established dips the treatment should result in a cure. If the latter method is followed failure to effect a permanent cure will result regardless of what kind of dip is used. It is a loss of time and money to dip sheep unless the work is done properly. Desired results can be accomplished only by performing every part of the work thoroughly and in accordance with approved methods.

DIPS FOR SCAB

READY-MADE PRODUCTS

Lime-sulphur and nicotine are the two dips commonly used in the United States for dipping sheep infested with scabies. The nicotine dips are sold under various trade names, and the percentage of nicotine in the product, as well as specific instructions for diluting the dip, should be given on the label of the container.

Proprietary brands of liquid lime-and-sulphur may be purchased, and many of them are equal to or even better than the homemade product. Manufacturers have also placed on the market a product commonly known as dry lime-sulphur, made by evaporating in a vacuum or in the presence of an inert gas, concentrated lime-sulphur solution to which a little cane sugar has been added to act as a stabilizing agent. The insecticidal constituents of dry lime-sulphur are readily soluble in hot water, and it is extensively used as a dip for animals and as an insecticide for plants. All ready-prepared dips should be diluted and used in accordance with instructions printed on the label of the container.

HOMEMADE LIME-AND-SULPHUR DIP

The lime-and-sulphur dip is made in the proportion of 8 pounds of unslaked lime (or 11 pounds of commercial hydrated lime, not air-slaked) and 24 pounds of flowers of sulphur to 100 gallons of water. Place the lime in a water-tight shallow box and add water enough to form a thin paste. Sift the sulphur into it and mix well until a paste of about the consistency of mortar is formed, adding

¹ CHAPIN, ROBERT M. A FIELD TEST FOR LIME-AND-SULPHUR DIPPING BATHS. U. S. Dept. Agr. Bul. 163. 1915.

water as required. Place this lime-and-sulphur paste in 30 gallons of boiling water and boil for at least two hours, adding water from time to time to maintain the quantity at 30 gallons, or in that proportion. During the boiling process the mixture in the boiling tank should be stirred well to prevent the paste from settling and caking on the bottom of the tank; the boiling process should be continued until all sulphur disappears from the surface. A large mortar hoe is a good implement with which to stir the boiling mixture. Both the lime and sulphur should be weighed; do not trust to measuring them in a pail or guessing at the weight. It sometimes happens that the sulphur is not all "cut" or dissolved; this is especially true if the lime is not of first-class quality. Those who have had considerable experience in the preparation of lime-and-sulphur dip sometimes add small quantities of extra lime if during the cooking they see that the sulphur is not being "cut" properly. It is advisable, however, for the beginner to hold strictly to the formula laid down, as an excess of lime in the dip will tend to injure the sheep and the wool. After the mixture has been boiled for two hours the liquid should be of a chocolate or dark-amber color.

The contents of the boiling tank should be drawn off or dipped out and placed in the settling tank, and allowed to stand until all sediment has settled to the bottom and the liquid is clear. The use of some sort of settling tank provided with a bunghole is necessary, unless the boiler is so arranged that it may be used for both boiling and settling. An ordinary water-tight barrel will answer very well for a settling tank at small vats. All settling tanks of every nature should have an outlet at least 4 inches from the bottom, in order that the clear liquid may be drawn off without its becoming mixed with any of the sediment (fig. 16). Drawing off the liquid as indicated above has an advantage over dipping it out, for the reason that in the latter case the liquid is stirred more or less and mixed with the sediment.

The prime object is to get the clear liquid without any sediment; the latter should under no circumstances be allowed in the dipping vat, as it will injure the wool and the eyes of the sheep.

When fully settled draw off the clear liquid into the dipping vat and add warm water sufficient to make a total of 100 gallons of dip. When mixed and cooked as specified above the concentrate is three and one-third times the strength required for the dip in the vat, so that to every 30 gallons of such concentrate 70 gallons of warm water should be added to make a dip of the required strength.

In preparing lime-and-sulphur dip in large quantities several hundred gallons of concentrate are often made at one time in a single large cooking tank. The quantity made at one boiling is limited only by the facilities at hand. If the boiling tank is of sufficient capacity, enough lime-and-sulphur paste should be cooked at one time to dip the flock. The quantity of mixture in the cooking tank may be varied at will, but the proportions of the various ingredients should not be altered.

NICOTINE DIP

The nicotine dip is made with sufficient nicotine solution to give a mixture containing not less than five one-hundredths of 1 per cent

(0.05 per cent) nicotine. Sufficient nicotine for 96 gallons (about 800 pounds) of dip would therefore be furnished by 1 pound of a 40 per cent solution of nicotine. The formula for this dip would be: Nicotine, 0.4 pound and water, 96 gallons.

To calculate how much nicotine solution should be used for 96 gallons of water, divide the quantity of nicotine required in the dip by the proportion of nicotine in the product. For example, suppose the nicotine solution contains 25 per cent nicotine, we have $0.4 \div 0.25 = 1.6$. Therefore in this case it would require 1.6 pounds of nicotine solution for the 96 gallons of dip. No preparation the strength of which is not given on the outside of the package should be used.

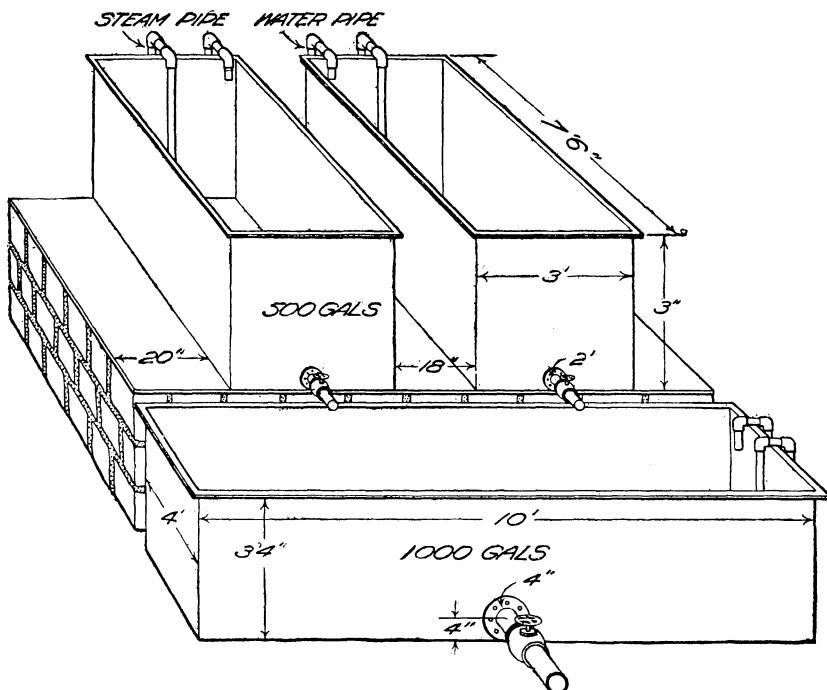


FIG. 16.—Cooking and settling tanks

The dip should on no account be heated above 110° F. after the nicotine solution is added, as heat is liable to evaporate the nicotine and weaken the dip.

DETERMINING CAPACITIES

One of the first steps in opening a dipping plant is to ascertain the capacity of the vat and the various tanks. The capacity of the vat is usually obtained in the following manner: In 1 gallon there are 231 cubic inches. Multiply the average length by the average width in inches, then the product by the depth; this will give approximately the number of cubic inches of space to be filled with dip.

Divide this by 231 and the result will be approximately the number of gallons of dip required to charge the vat.

To obtain the average length, add the length at the bottom to the length at the top (that is, at the line to which the vat is to be filled) and divide this sum by 2. Obtain the average width in the same manner. The depth should be taken at the center of the vat, and should be from bottom to dip line only and not to the top of vat. Likewise in determining the length and width measure only the space to be filled with liquid, and not above that line. The capacities of the various tanks are obtained by like process. Gauges or rods should be prepared and marked to show the number of gallons at various depths in the vat and tanks.

INJURY FROM DIPPING

Dipping often results in a slight setback to the sheep. There may be a temporary shrinkage in weight, constitutional disturbances, or both. Usually there are various factors operating to produce these conditions. They may occur with any of the standard dips, but should not always be attributed to the effects of the dip alone. The age and physical condition of the sheep, the method of handling the flock at the vat as well as before and after dipping, the character of the water used, the method of preparing the dip, and various other factors should be given consideration before placing the blame on the dip. Young animals in a thriving condition recuperate very rapidly from any temporary ill effects, but old, weak, or emaciated animals succumb very readily and regain lost weight slowly. Injury caused by dipping is more liable to result from improper methods of dipping and handling than from the direct effects of the dip. Rough handling of the sheep in the corrals and legging pens, dipping the flock immediately after a long, hard drive before they have rested and cooled off, dipping late in the afternoon when the nights are cold, keeping the sheep without feed and water for long periods before and after dipping, using dogs in the corral, and fighting stubborn sheep to get them into the chutes, are some of the contributing causes of injury.

Much of the water in the range country carries various quantities of mineral salts, and is commonly known as "alkali" water. Some of the dips do not seem to mix properly with many of these waters, and when they are used a separation apparently occurs, so that part of the sheep get too much of the active principle of the dip with resultant injury or death, while others get less than is required to kill the parasites. The lime-and-sulphur dip is about the only one that is safe to use with very impure water, although the nicotine dips mix well and are effective with most waters. Any of the dips if used too strong will injure the sheep.

In practical operations it is an established fact that lime-and-sulphur and possibly other dips are liable to cause serious injury to sheep if there are any puncture wounds. A condition commonly known as "blood poisoning" is produced, probably caused by micro-organisms entering the tissues and the action of the dip searing or sealing the wound so that the air is excluded and drainage stopped.

Pure lime-and-sulphur solution will not injure a sterile wound. The dip does not directly cause the "blood poisoning," but acts only as a contributing cause, and can be avoided by allowing wounds to granulate or heal before dipping. It may be stated that experience has demonstrated that when sheep are properly dipped in accordance with the rules of best practice in any of the approved dips the loss or damage is practically nil.

The question often arises as to the proper age at which lambs should be dipped to get the best results and cause the least damage. When the average lamb in a flock is 1 month old it is perfectly safe to dip the flock provided the lambs are dodged out and dipped separately. Any slight shrinkage caused at this time will be quickly regained, and the lambs will grow and thrive much more rapidly after being freed of the irritation caused by the scab mites. If the work is properly done and the sheep carefully handled pregnant ewes may with safety be dipped any time up to within one month of lambing.

There has been much controversy and argument concerning the effects that various dips have on the wool, and many experiments have been conducted and observations made over wide areas. The general opinion among the unprejudiced seems to be that the various well-

known dips properly prepared and used injure the wool very little, if any. It is necessary to eradicate scab to make woolgrowing profitable, or even possible. Lime-and-

sulphur and nicotine are among the dips that have been effective and have been generally used as scab eradicators, both in this and in other sheep-growing countries. It is therefore considered that any slight damage they may cause to the wool is more than equaled by their good effects in eradicating scab.

DIPPING VATS AND PLANTS

There are numerous kinds of dipping plants in use, the size and style varying according to the conditions which are to be met and the individual taste of the owner. The farmer who has but a small flock to dip can use a small portable vat as shown in Figure 17, turning a part of his barnyard or sheds into catch pens for temporary use, but if he is in the sheep business to stay he will find it advisable to make arrangements of a more permanent nature. Portable galvanized-iron dipping vats, called "hog vats," can be purchased ready-made and will answer the purpose very well for dipping small lots of farm sheep. A dipping bag is sometimes used for dipping when there are only a few sheep to be dipped at different points in a given section. For this purpose it has the advantage of being easily transported. It is made of heavy canvas, known in the trade as No. 40, and is constructed as follows: Two strips of canvas 8 feet long and 26 inches wide are sewed together to form a bag 48 inches

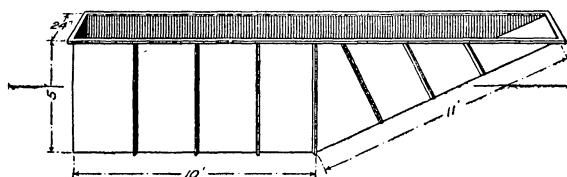


FIG. 17.—Portable galvanized-iron sheep-dipping vat

deep and 94 inches in circumference. Seams are triple-sewed, top and corners reinforced with leather strips riveted on (fig. 18). Iron rings held by leather ears are riveted to the upper part of the bag as shown in the cut. The bag is filled with dip, the sheep's feet tied, and the animal is set down in the bag and held the required length of time.

Heating tanks or boilers are necessary, the size varying with the number of sheep to be dipped. An ordinary iron caldron or kettle will answer the purpose for a small number of sheep. A rectangular galvanized-iron tank with large heating surface is preferable. Such a tank is set on two parallel walls, the walls forming the sides, and the bottom of the tank forming the top of the fire box. An opening large enough for the escape of the smoke should be provided at the end opposite that at which the fire is fed.

When large flocks are to be dipped it is necessary to provide proper facilities for the work, and a permanent dipping plant is the only practical solution.

SELECTING A LOCATION

In selecting a location for a dipping plant the fact that sheep work better upgrade should be given consideration, and if possible the ground used for the receiving corrals and chute should slope up to the end of the vat. The vat itself should be on level ground and preferably extend north and south, with the entrance at the south and the exit at the north, as it has been observed that sheep work better when not facing the sun. If the ground selected has good natural drainage it is a point in favor of the location.

CORRALS AND CHUTES

One of the important points in constructing a dipping plant is the arrangement of the corrals. Here is where much damage is often caused to the sheep and later attributed to the preparation in which they were dipped. The receiving corral into which the sheep are driven preparatory to dipping, as well as the holding corral into which they go from the draining pens, should each be large enough to hold a full band of sheep, or about 3,000 head. The receiving corral should be so constructed that there may be the least practical number of corners or places in which the sheep may become jammed or "piled up."



FIG. 18.—Dipping bag, made of No. 40 canvas

The nature of the sheep is such that in an effort to get out it will try to go back to the place where it entered the corral; therefore, if the entrance gate is near the vat the herd will tend to crowd toward the vat and thus save considerable work in getting them into the chute or catch pen. The corrals and chutes may be so arranged that a combination legging pen and running chute is provided. Sheep will usually work well in a chute the first time they are dipped at a vat, but with old ewes that have been dipped several times at the same vat it is often necessary to put them into the vat by hand. The location and arrangement of the chutes are sometimes changed from year to year so the sheep may not recognize them so readily. The running chute should be curved to obstruct the view, and the side on which the men work should be tight boarded. The usual height for the sides of the chute is 40 inches. Sheep work well uphill, but not down an incline; the chutes and alleys, therefore, should be upgrade to the vat. If necessary, elevate the running chute so that it slants upward to the slide board. A small pen should be provided near the entrance to the vat and so arranged that the sheep may see it. This pen, known as a "decoy pen," is filled with sheep to induce the other members of the flock to work toward the vat more readily in their efforts to join those in the pen. The size and arrangement of the corrals will necessarily vary with the topography of the location and the individual ideas or tastes of the owner.

DRAINING PENS

When a sheep emerges from the vat it carries out a large quantity of dip in the fleece. The major portion of this dip drains out of the fleece very rapidly, and it is desirable that it be saved and returned to the vat. Draining pens with water-tight floors sloping toward the vat should therefore be provided. The size will depend on the size of the plant and the number of sheep to be dipped. The relative size shown in the plans illustrated in Figures 19 and 20 may be followed, increasing or decreasing the size of the pens to correspond to the length of the vat. There should be two draining pens, each having an opening into the holding corral. They may be made of lumber or concrete, and should have catch basins or screening and settling wells into which the dip drains so as to prevent manure and foreign matter from being carried into the vat. Drawings of screening and settling wells will be found in the plan of the cement dipping plant in this bulletin (fig. 20). In constructing drainage pens of concrete it is advisable to build the outer walls in the same manner as the foundations for a house, except that they are to be six inches thick. The space inside these walls is then filled with gravel to the required height and the floor laid on it. Concrete floors should have rough surfaces to prevent slipping. A coat of "pebble dash" over the concrete floors will afford a suitable surface for the sheep to stand on. The floors of draining pens should slope so that the dip will drain away rapidly and not collect in pools from which the animals may drink.

VATS

The dipping vat may be constructed of either lumber or concrete, the concrete vat being preferable. The length of the vat may vary

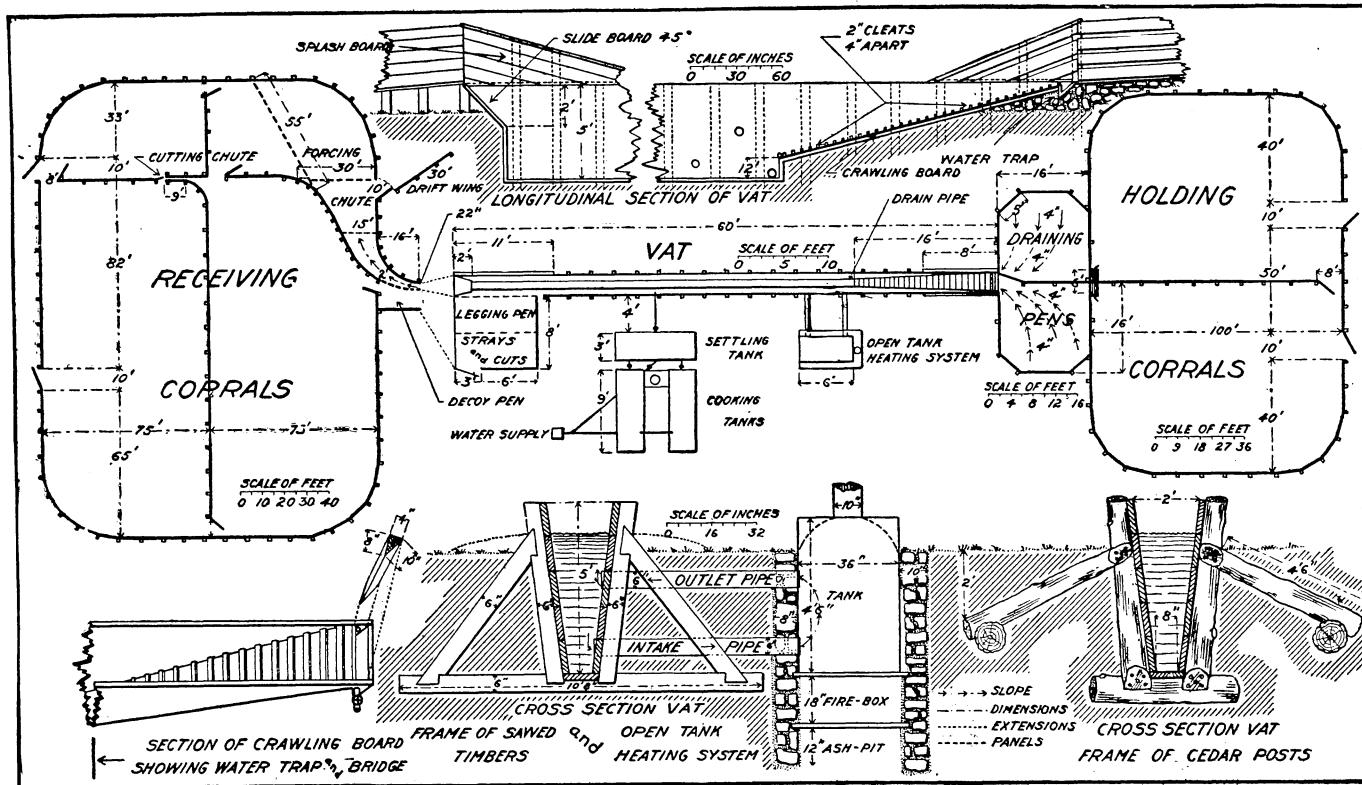


FIG. 19.—Plan of sheep-dipping plant; wooden vat

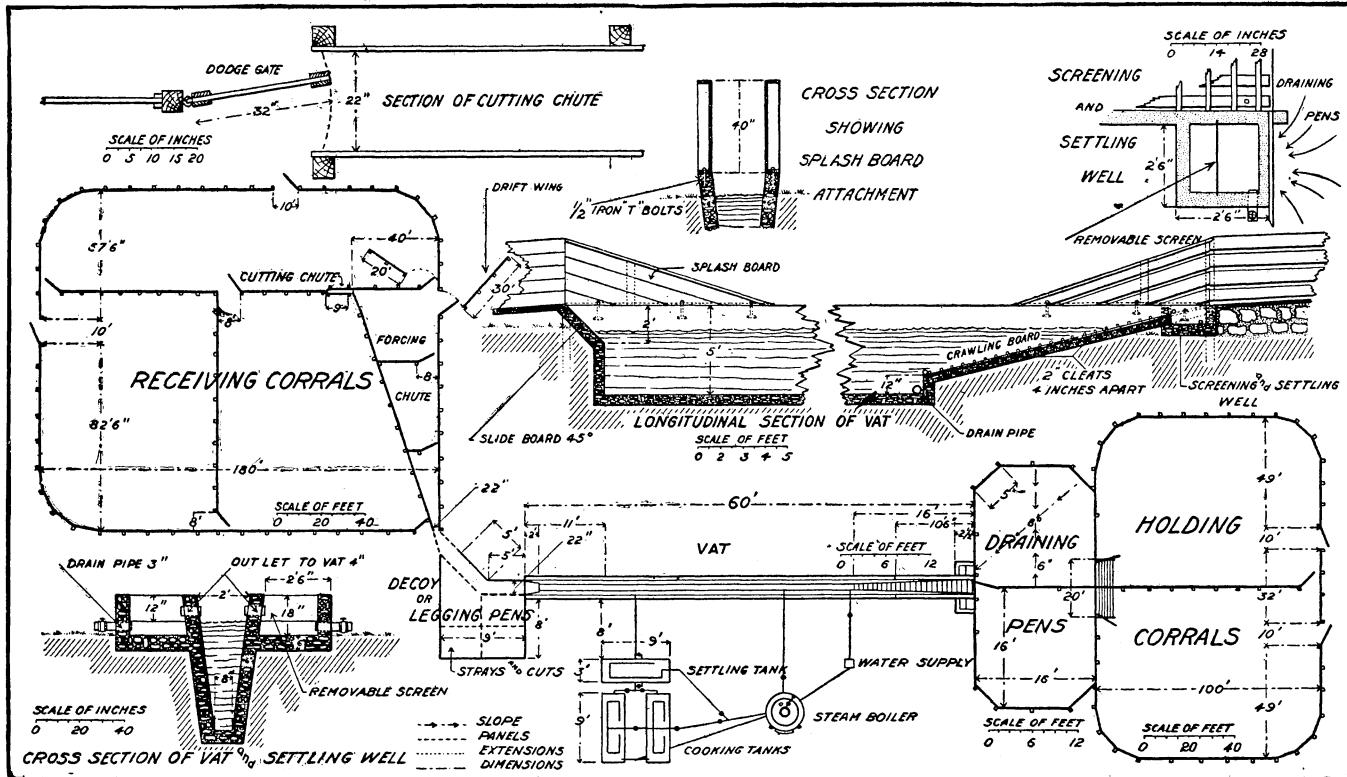


FIG. 20.—Plan of sheep-dipping plant; concrete vat

from 30 to 100 feet, depending on the number of sheep to be dipped. Public dipping vats, where from 50,000 to 100,000 sheep are dipped each season, should be 100 feet long. The depth should be 5 feet, width at bottom 8 inches and at top 2 feet. Sheep vats are usually so constructed that the top is flush with the top of the ground, and there should be no crosspieces to interfere with free action of the sheep or of the men working along the vat. As a matter of individual taste, however, the top of the vat may extend from 9 to 18 inches above the ground. Those of the latter kind afford a better opportunity to handle the sheep and can be operated with less effort. If it is desired that the top of the vat shall be flush with the ground, it should first be built at least 4 inches above the natural surface of the ground and then dirt or gravel may be filled in, thus obtaining proper drainage along the sides.

Whenever it is possible to do so the gravity method of draining the old dip out of the vat should be adopted, as otherwise it is necessary to pump or dip it out each time the vat is cleaned. The end of the vat having the drain should be slightly lower than the other end, so that all the liquid will drain off. The slide board into the vat should be set at an angle of 45° and extend from the floor of the chute to at least 4 inches below the dip line; it should be made of or covered with a smooth-surfaced material, such as planed lumber or sheet metal. The end extending into the dip should be flush with the vertical end of the vat. A space between the slide board and the end of the vat, if large enough for a lamb to lodge in, is a dangerous arrangement. The runway leading out of the vat should not be too steep. The length varies from 8 to 16 feet, the latter being preferable in large vats.

HEATING FACILITIES

When lime-and-sulphur dip is used it is necessary to provide cooking tanks. The cooking may be done by steam or in open boilers having a fire box under each. All large plants should have steam boilers of not less than 25 horsepower. The live steam can be piped into the dipping vat and used for maintaining the temperature of the dip, and also into the cooking and heating tanks for boiling the dip or heating water. The steam pipes should extend along the floor of the vat at least two-thirds of the length and be provided with openings for the escape of the steam into the dip. The supply pipe from the settling tank should enter the vat above the dip line, in order that any leak may easily be detected.

CARE OF PLANT WHEN NOT IN USE

A dipping plant that does not receive proper care when not in use deteriorates very rapidly. The pressure of the ground against the sides of the vat tends to cause them to bulge inward; this tendency may be counteracted to some extent by keeping the vat full of liquid. Wooden vats which are allowed to stand empty dry out, and the lumber shrinks so that the vat will leak when refilled. At the close of dipping operations the vat should be left full of liquid and water added from time to time to restore that lost by evaporation.

A week or 10 days prior to beginning dipping operations the entire plant should be overhauled and put in good condition. Before charging a new vat or one which has stood empty for some time, it should be filled with water to ascertain whether it leaks.

CONSTRUCTION OF DIPPING PLANTS

Plans for the construction of concrete and wooden sheep-dipping plants are shown in Figures 19 and 20. They are not drawn to a uniform scale; consequently, in studying the drawings the scale of each part should be noted. The plants as shown have no superfluous equipment and the arrangements are as simple as is consistent with efficiency. The size of the plant can be increased or decreased as desired. A different corral, chute, and legging-pen arrangement is shown with each vat. All parts are interchangeable and are suitable for use with either vat. Cross fences as desired can be added to the corrals. Cutting chutes are shown in both plans, as every large dipping plant should have a chute equipped with a dodge gate, so the lambs may be cut out and dipped separately.

If permanent pipes are used for conducting water and dip to the vat they should be so laid as not to act as an obstacle to the men working along the vat. There should be no obstructions to the path along both sides of the vat. The pipes can be placed under the ground, or a portable V-shaped trough can be used for conducting liquids into the vat and laid aside when not in use.

THE WOODEN VAT

As shown in the plans for the wooden vat, one side of the running chute is made of portable panels, so they may be shifted and the space converted into a legging pen. Two styles of framing are shown. In the cedar-growing sections the cedar-post frames are preferable because they do not decay rapidly, while the sawed white-pine timbers do. Where hardwood is used instead of white pine the frame timbers need not be so heavy; 4 by 4 inches is heavy enough for framing in hardwood. The frames are set from $2\frac{1}{2}$ to 4 feet apart, depending on the character of the soil and the material used; $2\frac{1}{2}$ feet apart is a safe rule, as the closer the frames are to each other the less tendency there is for the sides of the vat to bulge in between the frames. Two-inch tongued-and-grooved planks should be used in making the vat, and they should be beveled so all joints and seams may be properly calked with oakum or similar material.

THE CONCRETE VAT

In the plan for the concrete plant the corrals and chute are very conveniently arranged. The portable panels can be shifted to form either a running chute or a legging pen. The settling and screening wells shown can also be constructed as a part of any vat by changing the slope of the draining pens so the dip will run into the wells instead of down the runway. In making the forms for a draining well the groove into which the removable screen is to sit should be provided for, as well as the 4-inch opening into the vat.

The trench for a concrete vat should be excavated so the inside dimensions correspond to the outside dimensions of the vat when

completed. If the sides of the trench are smooth and reasonably firm they can be used as the outer wall of the form, but in all cases where the vat is extended above the surface of the ground it is necessary to build forms extending from the surface of the ground to the top of the vat. If the soil is sandy it will be necessary to build outer forms, in which case the trench should be wide enough to allow for these forms. The drain and other pipes shown in the drawing should be placed in the form and all should be threaded and capped, so proper connections may be made. Three pairs of one-half-inch bolts should be embedded in the concrete of the incline for attaching the false floor or runway. This floor is made of 1 by 6 inch boards laid lengthwise with cross cleats, as shown in drawings. Two pairs of bolts also should be embedded for attaching the slide board. Steam pipes should not be molded into the concrete walls, as the vibration of the pipes will crack the cement. They should pass over the top of the vat and down the side in a groove formed in the wall, so they will not come in contact with the sheep or cause annoyance to the men working along the vat.

The walls should be made 6 inches thick, constructed of concrete mixed in the proportion of 1 part cement, $2\frac{1}{2}$ parts sand, and 4 parts broken stone or gravel. This mixture is slushed into forms properly set, and when it approaches dryness the forms are removed and the inside surface of the vat coated with pure cement mixed to about the consistence of cream and applied with a brush. It is important that this coating be well brushed in so as to fill all cavities and form a smooth surface.

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